THIS OPINION WAS NOT WRITTEN FOR PUBLICATION

The opinion in support of the decision being entered today (1) was not written for publication in a law journal and (2) is not binding precedent of the Board.

Paper No. 15

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte STUART B. HORN
and ELIZABETH H. NELSON

Appeal No. 95-3674
Application 08/122,981[1]

ON BRIEF

Before THOMAS, BARRETT, and TORCZON, Administrative Patent Judges.

BARRETT, Administrative Patent Judge.

DECISION ON APPEAL

[1] Application for patent filed September 20, 1993, entitled "Nanoporous Semiconductor Material And Fabrication Technique For Use As Thermoelectric Elements."

This is a decision on appeal under 35 U.S.C. § 134 from the final rejection of claims 7-13. Claims 1-6 and 14 have been withdrawn from consideration as being directed to a non-elected invention.

We reverse.

The disclosed invention is directed to thermoelectric elements made from "nanoporous" semiconductor material.

Claim 7, the sole independent claim, is reproduced below.[2]

> 7. A process of using a nanoporous semiconductor material in a multiple stage thermoelectric device including the steps of:
>
> providing a nanoporous semiconductor material;
>
> fabricating p-type and n-type thermoelectric semiconductor elements from the nanoporous semiconductor material;
>
> incorporating the p-type and n-type thermoelectric nanoporous semiconductor elements to provide a peltier couple whereby when a current is passed through the couple there is effected a release or requirement of energy due at least in part to changes in transport energy within the peltier couple;
>
> mating multiple peltier couples together to form a multiple stage thermoelectric device whereby energy from one stage is used as input to the next stage effecting a larger temperature difference.

The examiner relies on the following references:

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[2] We note that claim 7 should have an "and" before the last step of "mating." In addition, "peltier" should be capitalized.

Hanson	4,718,249	January 12, 1988
Yokotani et al. (Yokotani)	5,168,339	December 1, 1992

Claims 7-13 stand rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which appellants regard as their invention. The examiner states (Examiner's Answer, pages 2-3): "claims 7 to 13 which purport to be both process of using and process of making are ambiguous and therefore does [sic] not particularly point out and distinctly claim subject matter of invention."

Claims 7-9 and 12 stand rejected under 35 U.S.C. § 103 as being unpatentable over Yokotani. The examiner states (Examiner's Answer, pages 3-4):

> Yokotani discloses a porous semiconductor material, p-type and n-type thermoelectric elements formed in the porous semiconductor material. Figure 1 of Yokotani clearly show [sic] a multiple thermoelectric elements couples together to form a multiple stage thermoelectric device. It is well known that the thermoelectric elements disclosed by Yokotani provide the peltier couple.

Claims 10, 11, and 13 stand rejected under 35 U.S.C. § 103 as being unpatentable over Yokotani further in view of Hanson. The examiner states (Examiner's Answer, page 4): "Hanson teaches that thermoelectric device can be used in heat pump, generator and air conditioner."

We refer to Examiner's Answer (Paper No. 14) for a statement of the examiner's position and to the Appeal Brief (Paper No. 13) for a statement of appellants' position.

OPINION

35 U.S.C. § 112, second paragraph

In our opinion, one of ordinary skill in the art would interpret claim 7 as directed to a method of making a multiple stage thermoelectric device as evidenced by the steps of "providing," "fabricating," "incorporating," and "mating." The fact that the method is claimed as using a nanoporous semiconductor material in the fabrication does not create any ambiguity. The rejection of claims 7-13 is reversed.

35 U.S.C. § 103

Appellants argue (Brief, pages 4-5):

> Yokotani et al. discloses a composite structure where the porous component disclosed is not a semiconductor material but is in actuality function [sic] as insulators. As disclosed on column 2, lines 63-66 in the summary portion of the Yokotani et al reference: "each semiconductor element consists of a porous material or gas permeable support particles and a thermoelectric semiconductive material supported by said support particles."

Claim 7 calls for "providing a nanoporous semiconductor material" and then "fabricating p-type and n-type thermoelectric semiconductor elements from the nanoporous semiconductor material." The "fabricating" step does not specify any details of the construction and is broad enough to include nanoporous material on support particles if that construction is possible.

Appellants argue that "Yokotani el al. does not disclose a nanoporous semiconductor material, so that everywhere in Applicant's claims where there is claimed a nanoporous semiconductor material, Applicant has clearly defined over the prior art of record" (Brief, page 5). Thus, the question is whether Yokotani discloses a nanoporous semiconductor material.

The specification states (page 5): "Nanostructured materials include building blocks on the order of nanometers (10^{-9} meters) or tens of nanometers." This definition of "nanostructured" material is confirmed by the article, incorporatd by reference in the specification, by Ron Dagani, Nanostructured Materials Promise To Advance Range of Technologies, Chemical and Engineering News, 23 November 1992, pages 18-24, at page 18:

> Nanostructured (or nanophase) materials are called that because the size of their building blocks is on the order of nanometers (10^{-9} meter) or tens of nanometers. Generally speaking, any material that contains grains or particles 1 to 100 nm across, or layers or filaments of that thickness, can be considered a nanostructured material.

However, the claims recite a "nanoporous" material, not a "nanostructured" material. We do not find the term "nanoporous" defined in the specification except indirectly by the process of fabrication in figure 1 wherein fine particles,

assumed to be nanostructured, are compacted and sintered to produce a nanoporous body. Appellants do not define "nanoporous" in their arguments. While there are definitions of "nanoporous" in the literature,[3] it is not known whether the term has a generally accepted definition in the prior art. It is not known whether "nanostructured" materials are inherently "nanoporous"; however, it appears from the definition in the Dagani article that a "nanostructured" material merely has to contain small grains and does not necessarily have to be compacted and sintered. We define "nanoporous," consistent with the specification, to mean a product produced by the process in figure 1, which requires steps of compacting and sintering a nanostructured powder.

The examiner relies on the fifth preferred embodiment of Yokotani. As shown in figure 6, "a glass balloon material having an average particle size of 8μm and a film thickness of 0.5 μm is used as support particles" (col. 7, approx. lines 43-45). Yokotani discloses that the p-type or n-type semiconductor materials are "milled into a powder having an average particle size of 0.08 μm" (col. 7, approx.

[3] For example, U.S. Patent 5,594,263 states (col. 1, lines 64-67): "By nanoporous is meant a material which has a crystallographically regular intracrystalline pore system whose pores have an average diameter of 2.5 to about 30 Å."

lines 50-51), mixed with solvent to make a slurry, and mixed with the glass balloon material to produce a semiconductive layer on the glass balloon. The examiner states (Examiner's

Answer, page 5):

> Line 51 of column 7 discloses an "average particle size of 0.08μm" which is equal to 80 nanometers. Therefore the term "nanoporous" is obvious over the teachings of Yokotani. Even the size of 8000 nanometers (8 μm) as disclosed in line 43 of column 7 is obvious over the term "nanoporous" because the particle size can be measured in nanometers.

The examiner does not come to grips with the "nanoporous" limitation. The fact that the particles in the layer of figure 6 are on the order of tens of nanometers does not make the layer a "nanoporous" material because the particles have not been compacted and sintered. We do not agree with the examiner's statement that a material is "nanoporous" because the particle size can be expressed in nanometers. Any object's size can be expressed in nanometers, but "nanostructured" requires a size less than 100 nanometers.

In addition, claim 7 calls for "providing a nanoporous semiconductor material" and then "fabricating p-type and n-type thermoelectric semiconductor elements from the nanoporous semiconductor material." Thus, claim 7 calls for making p-type and n-type semiconductors out of nanoporous material, apparently in accordance with the disclosure in the specification that there can be "additional doping after fabrication" (specification, page 4, lines 14-15). Claim 7 does not encompass forming the nanoporous material using p-type

or n-type doping in the process of making the nanoporous material as shown in the optional step 11 in figure 1. Yokotani starts with a p-type or n-type semiconductor which is milled to form the small particles. Thus, even if Yokotani disclosed p-type and n-type nanoporous materials, it does not produce them by the fabricating p-type and n-type semiconductor elements from a nanoporous material.

For the reasons stated above, the rejection of claims 7-9 and 12 over Yokotani is reversed. Because claims 10, 11, and 13 incorporate all of the limitations of claim 7, and because Hanson does not cure the deficiency of the nanoporous material in Yokotani, the rejection of claims 10, 11, and 13 is reversed.

CONCLUSION

The rejections of claims 7-13 are reversed.

REVERSED

JAMES D. THOMAS Administrative Patent Judge	)	
LEE E. BARRETT Administrative Patent Judge	)	BOARD OF PATENT APPEALS AND INTERFERENCES
RICHARD TORCZON Administrative Patent Judge	)	

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